



UNITED STATES DEPARTMENT OF COMMERCE  
National Oceanic and Atmospheric Administration  
NATIONAL MARINE FISHERIES SERVICE  
Northwest and Alaska Fisheries Center  
Resource Assessment & Conservation Engineering  
2725 Montlake Boulevard East  
Seattle, Washington 98112

September 13, 1982

CRUISE RESULTS  
NOAA RV CHAPMAN  
Cruise 82-1, Leg 11

Eastern Bering Sea Pollock Acoustic-Trawl Survey

April 14 - May 7, 1982

During April 19 to May 7, 1982 the NOAA research vessel CHAPMAN completed an echo integrator-trawl survey of walleye pollock (Theragra chalcogramma) in the outer continental shelf-upper slope area of the Bering Sea between Unimak Island and the Pribilof Islands. The vessel's itinerary was as follows:

April 14-16: Equipment installation in Kodiak; 2 days lost to weather  
April 17-19: Transit from Kodiak to Unimak Pass  
April 20-May 6: Acoustic trawl survey; 2 days lost to weather  
May 7: End cruise at Dutch Harbor.

OBJECTIVES

The survey was conducted to obtain information on the feasibility of conducting acoustic-midwater trawl surveys of the eastern Bering Sea pollock resource during the spawning season. Its principal objective was to collect data on the distribution, abundance, schooling behavior, and biological composition of off-bottom aggregations of pollock. Other objectives were to: (1) collect pollock ovaries for fecundity and oocyte development studies, (2) obtain pollock stomach and zooplankton samples for feeding habit studies, and (3) obtain data on the size composition of pollock available to bottom trawls for comparisons with midwater trawl data.

ACOUSTIC EQUIPMENT AND TRAWL GEAR

Acoustic data were collected and processed with a Biosonics, Inc. Model 101 echo sounder (38 kHz) and a Model 101 digital echo integrator. The integrator was interfaced to a TRS 80 Model III minicomputer with floppy disks used to store the integrator output. The system's transducer was mounted in a 2-ft V fin towed behind the vessel. In addition to the real time processing, some of the acoustic data were simultaneously recorded in analog form on cassette tape.

Midwater trawling was done with a Diamond 1000 trawl fished with 6 X 9 ft steel V doors and 30 fathom dandyline. A 1.5 inch mesh (stretched measure) liner was installed in the codend. The average



vertical mouth opening of the trawl was 9-10 fathoms. Bottom trawl hauls were made with an 83/112 modified Eastern trawl which had a 1.5 inch (stretched measure) codend liner. The bottom trawl was fished with the same doors used with the midwater trawl. A Simrad cable netsounder was used during each trawl haul. The vessel's average trawling speed was approximately 3 knots. A Tucker trawl was used for zooplankton sampling. Water temperature/depth profiles were obtained using an XBT system.

### SURVEY METHODS

The survey was conducted 24 hours per day along a zig-zag trackline which generally was run between the 50 and 250 fathom isobaths (Fig. 1). The survey area was covered in a SE to NW direction from April 21 to April 27 (transects 1-10) and again in the opposite direction between April 29 and May 6 (transects 11-24). The V fin was towed at a depth of 7 m and an average speed of 8 knots. Echo integration outputs (relative density estimates) were computed every 5 minutes for each 10 m depth stratum from the transducer to a depth approximately 3 m above the bottom.

Midwater trawl hauls were made to identify echo sign and collect biological data on pollock. Bottom trawl hauls were made at selected locations to obtain data on the size composition of pollock near bottom. Tucker trawl hauls were made in conjunction with some of the midwater trawl hauls made after sunset. An XBT cast was made at each trawl station.

Standardized catch sorting and sampling procedures were used to determine the species composition of each trawl catch and to obtain biological data on pollock and other species. Each catch was completely sorted by species. When possible, a random length-frequency sample of approximately 300 pollock was collected for each haul. This sample was randomly subsampled to provide 50 males and 50 females which were used to obtain otoliths and maturity data. When more than one haul was made in the same location, only one was sampled for otoliths. Pollock length-weight measurements were collected according to a length stratified scheme which provided up to 25 individual fish weights per 1 cm length interval. Pollock stomachs were also collected from each haul. For each haul, between 5 and 10 stomachs were collected from each 5 cm length class. Length stratified samples of pollock ovaries were collected for both the fecundity and oocyte development studies.

### RESULTS

Echo integration data were collected continuously on a 1,700 nautical mile trackline composed of 24 transects (Fig. 1). Twenty-three midwater trawl and two bottom trawl hauls were made during the survey (Fig. 2). Pollock was the dominant fish species in each of the midwater hauls (Table 1). Jellyfish also occurred in most midwater hauls and were a substantial part of the catch at several locations (Haul Nos. 5, 7, 19, 23, 24, and 25). Small amounts of Pacific cod were taken in 12 of the 23 midwater hauls. The quantity of species

other than pollock, jellyfish, and cod in midwater trawl catches was insignificant. Six Tucker trawl hauls were made during the survey. The Tucker trawl catches were primarily copepods and chaetognaths.

Pollock echo sign was encountered throughout the survey region, The highest apparent densities were found between the 50 and 75 fathom isobaths just north of Unimak Island and slightly east of St. George Island. In some parts of the survey area, the presence of jellyfish made accurate identification of echo sign difficult and complicates analysis of the echo integration data.

Pollock caught in the Pribilof Islands area (Hauls 11-14) were generally smaller (mean length  $\approx 36$  cm) than those to the south (mean length  $\approx 40$  cm) (Fig. 3). In the two instances when bottom and midwater trawls were made in the same location, the average size of adults (fish  $>20$  cm) taken on bottom was greater than in midwater (Fig. 4). The only juvenile pollock (fish  $\leq 20$  cm) caught during the survey were taken in one of the two bottom trawl hauls (Haul No. 9). Variation in the sex ratio of pollock by haul is shown in Fig. 5.

Pollock maturity data indicate that the survey was carried out after the peak of the spawning period. Approximately 70% of the males were in a post-spawning condition, while 20% were spawning (running ripe) and 10% were in a prespawning condition. The maturity composition of females was similar to that of the males. About 55% of the females had spawned, 20% were actively spawning, and 25% were in a prespawning condition.

The numbers of pollock sampled for different types of biological data/samples were: length measurements, 6,869; length-weight measurements, 475; maturity stage, 2,256; otoliths, 1,700; stomachs, 225; ovaries, 50.

#### SCIENTIFIC PERSONNEL

Jimmie Traynor, Chief Scientist	NWAF
Neal Williamson, Statistician	NWAF
Jan McCrory, Biological Technician	NWAF
Marcelle Van Houten, Biological Technician	NWAF
Eric Stirrup, NOAA Corp Officer	NWAF

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Table 1.--Trawl haul stations and catch data, CHARMAN Cruise 82-1, Leg II.

Haul 1/	Date (1982)	Start Pos.		Time of Day	Depth (fm) gear/bottom	Temp (°C) Surface/gear	Duration (hr)	Dist. Fished (n.m.)	Catch (lbs) 2/			
		Lat(N)	Long(W)						Walleye Pollock	Jellyfish	Pacific cod	Other Species
1	4/22	54°46'	165°17'	1100	35/86	3.2/-	0.1	.6	314	5	--	7
2	4/22	54°47'	165°17'	1200	77/77	3.2/3.7	0.3	1.4	856	2	45	107
3	4/22	54°47'	165°10'	1300	52/57	3.3/3.2	0.3	1.8	1926	80	81	--
4	4/22	54°47'	165°16'	2200	45/83	2.9/3.2	0.6	2.2	1769	40	41	1
5	4/23	55°39'	164°13'	1900	37/54	2.7/1.7	0.5	2.0	264	200	31	--
6	4/24	54°43'	166°10'	1300	95/155	3.2/3.9	0.7	2.7	2	--	--	--
7	4/24	55°01'	165°39'	1900	50/70	1.9/3.7	1.3	3.7	121	1500	--	3
8	4/26	56°11'	166°39'	1600	44/62	2.4/2.3	0.7	2.7	1812	148	7	--
9	4/26	56°11'	166°39'	1800	65/65	2.4/2.3	0.5	1.5	532	--	902	906
10	4/26	56°11'	166°39'	2200	35/63	1.9/2.3	0.7	2.7	707	60	70	--
11	4/29	56°47'	171°01'	1000	52/61	2.4/2.7	1.0	3.3	381	--	--	--
12	4/30	56°22'	170°07'	0400	52/62	2.1/3.0	0.8	2.5	1582	--	74	5
13	4/30	56°19'	169°30'	0900	80/92	1.8/3.9	0.2	0.9	271	--	--	--
14	5/1	56°35'	168°35'	2300	51/62	2.3/2.4	0.5	1.5	648	32	3	5
15	5/2	56°17'	167°48'	0900	64/74	2.8/4.1	0.5	1.5	25	--	--	--
16	5/2	55°31'	168°11'	1900	75/90	2.9/3.7	1.5	4.5	60	5	12	T
17	5/2	55°29'	168°13'	2300	75/90	2.5/3.7	0.6	2.0	305	--	14	--
18	5/3	55°50'	167°29'	0800	57/74	2.9/4.2	0.5	1.5	1294	--	--	T
19	5/3	56°30'	167°09'	1600	45/59	3.5/1.8	0.3	1.1	225	260	--	--
20	5/4	56°05'	166°04'	0400	50/64	2.6/2.0	0.8	2.4	2094	340	19	T
21	5/4	54°59'	166°45'	1600	73/83	3.4/3.8	1.2	3.4	211	20	--	6
22	5/5	55°39'	165°31'	0600	45/64	3.0/2.8	0.3	.9	1712	350	12	T
23	5/5	56°19'	164°47'	1300	39/48	2.9/0.7	1.0	2.8	338	553	15	--
24	5/6	55°19'	165°10'	1100	23/61	4.0/2.7	0.5	1.5	20	70	--	--
25	5/6	55°20'	165°11'	1200	48/61	4.0/2.7	0.3	1.0	270	1065	--	--

I/ Hauls 2 and 9 are bottom trawl hauls; all others are midwater trawl hauls. 2/ T indicates catch less than 1 pound.

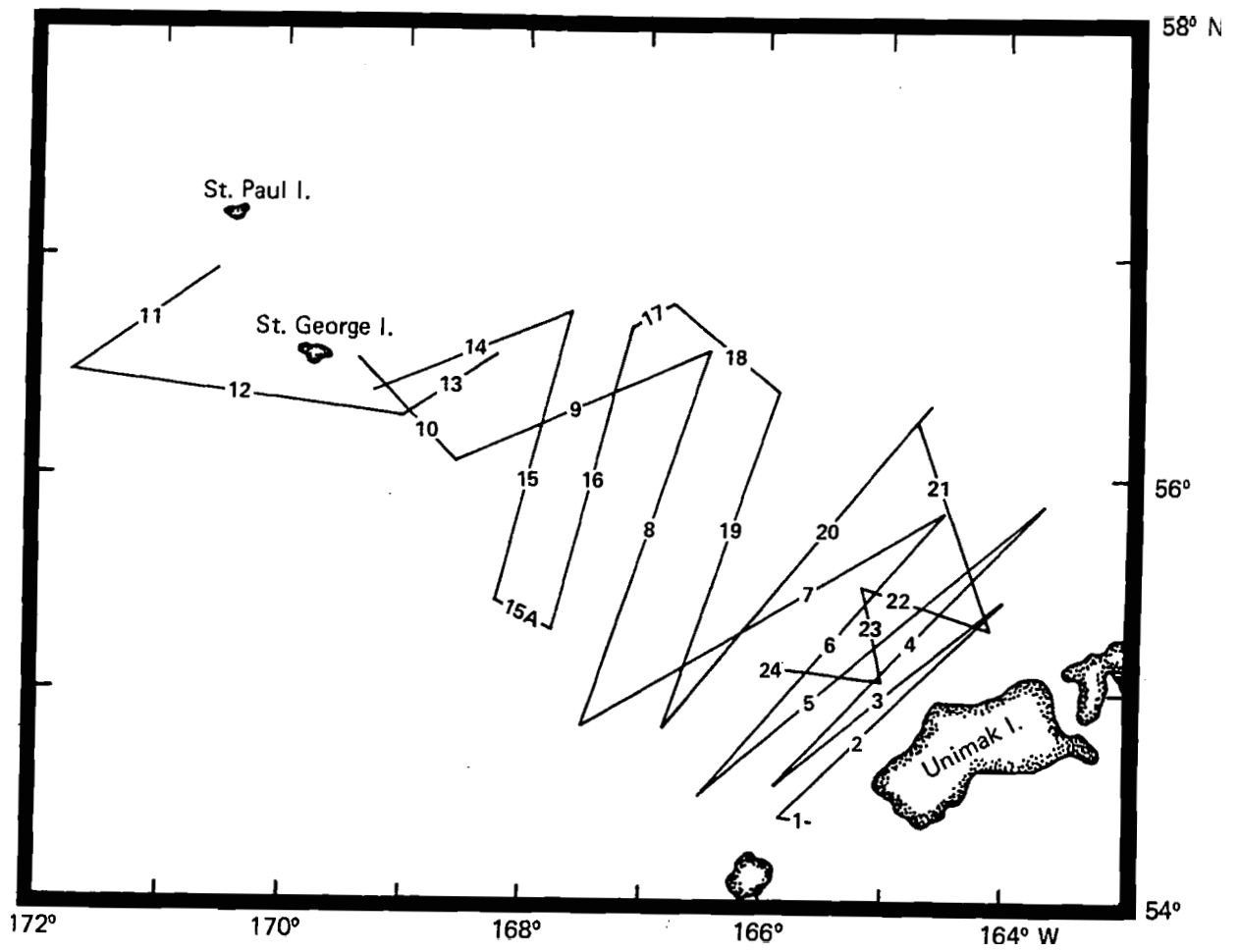


Fig. 1.--Acoustic survey trackline, CHAPMAN Cruise 82-1, Leg II.

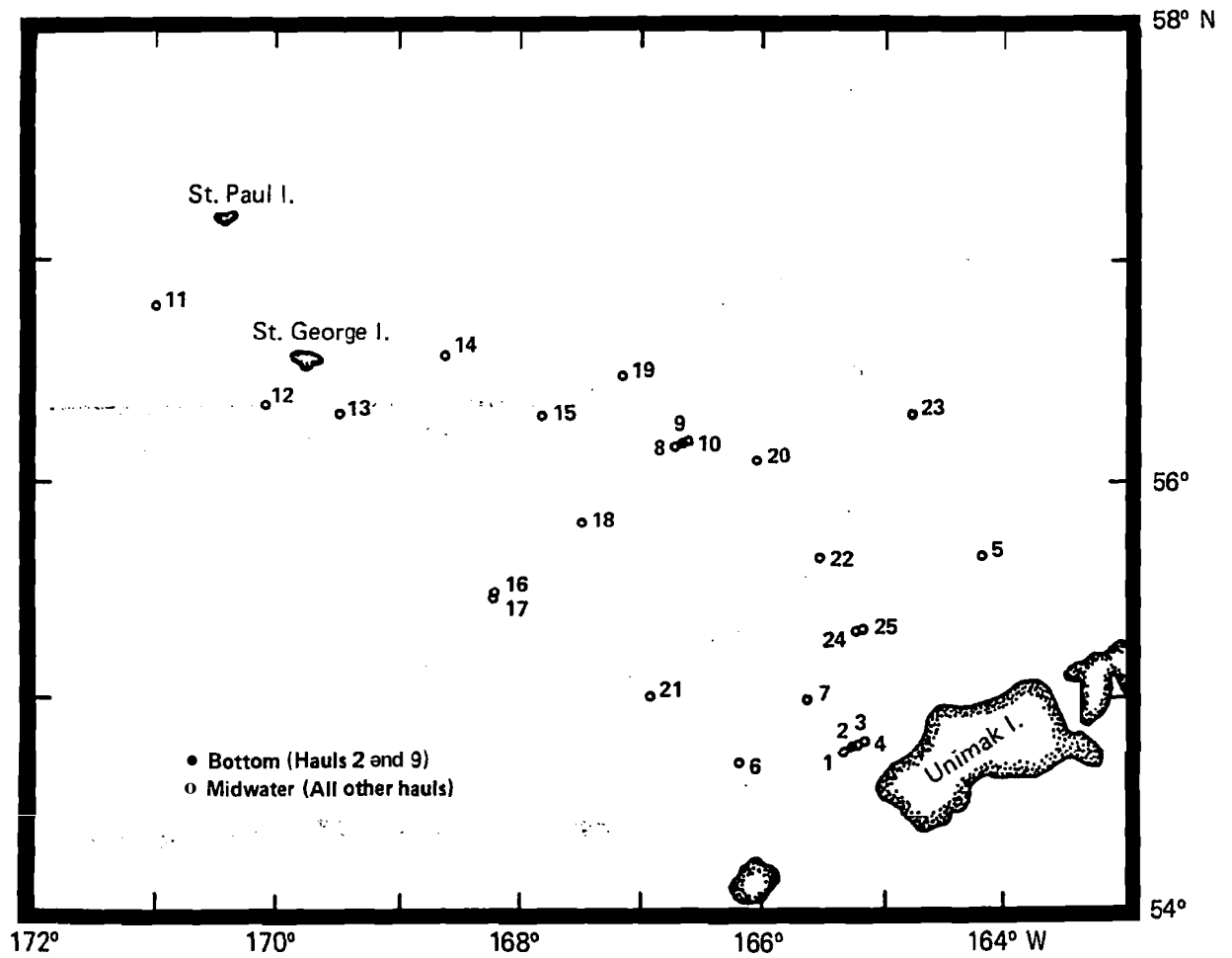


Fig. 2.--Midwater trawl and bottom trawl stations, CHAPMAN Cruise 82-I, Leg II.

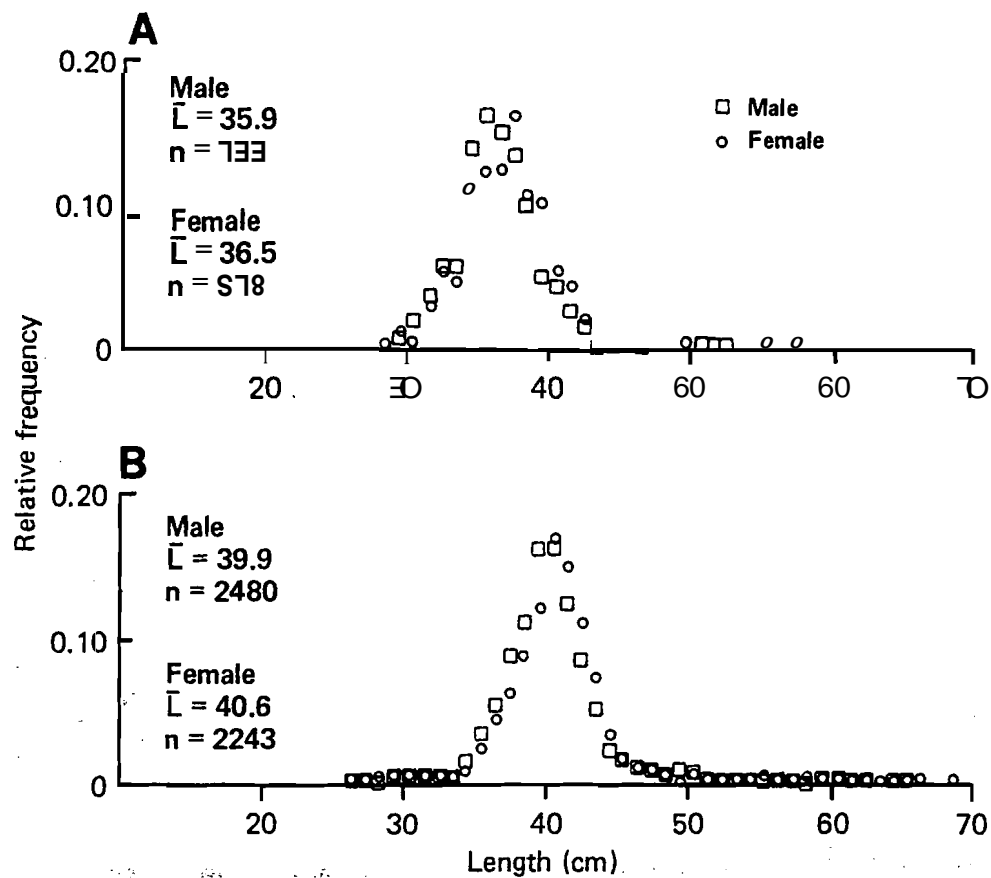


Fig. 3.--Length distributions of pollock, by sex, in midwater trawl hauls. **A** indicates hauls made near the Pribilof Islands (Nos. 11-14; Fig. 2, Table 1). **B** includes all other midwater hauls.

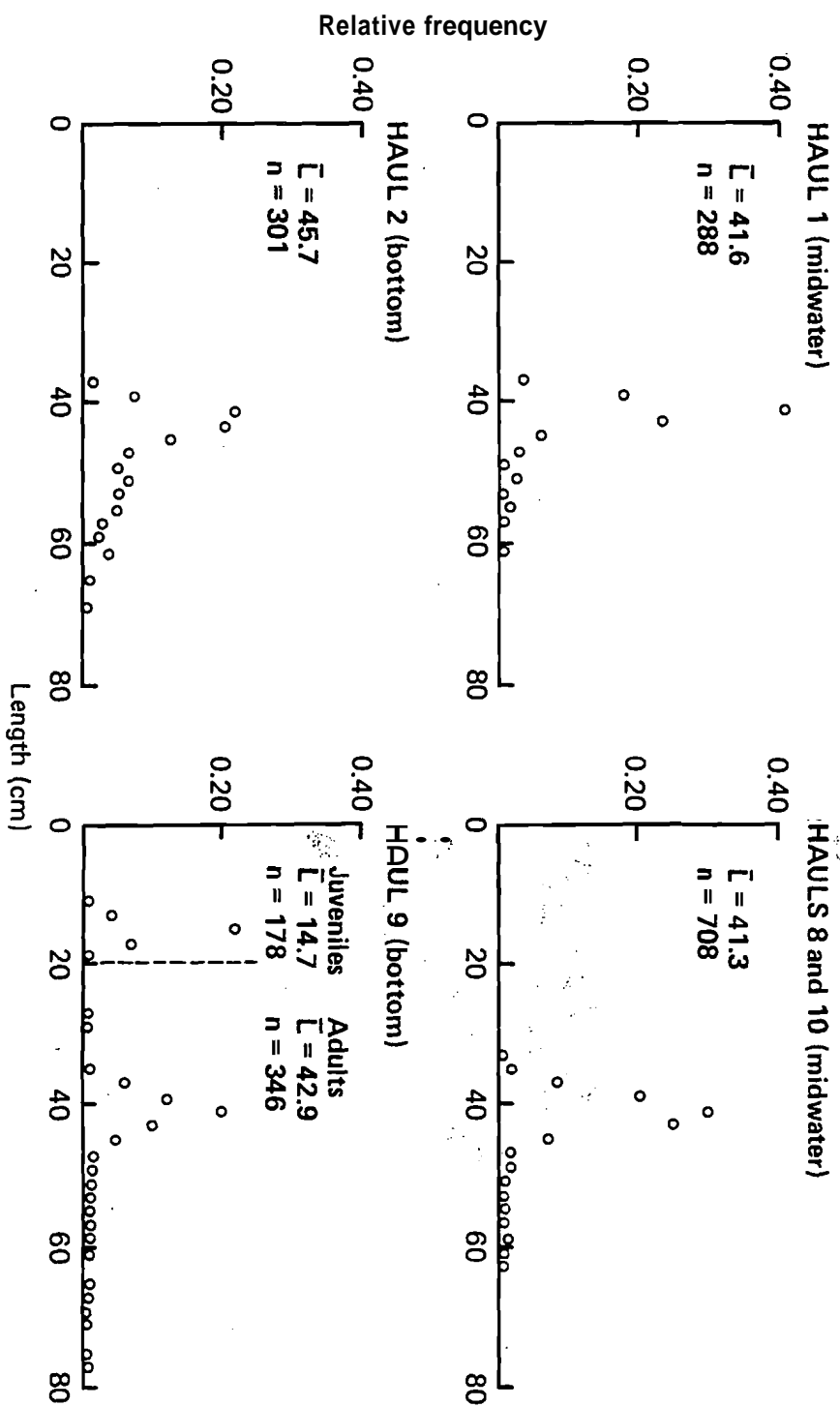


Fig. 4.--Comparison of pollock length distributions (sexes combined) between midwater trawl and bottom trawl hauls (Haul 1 vs Haul 2; Hauls 8 and 10 vs Haul 9).



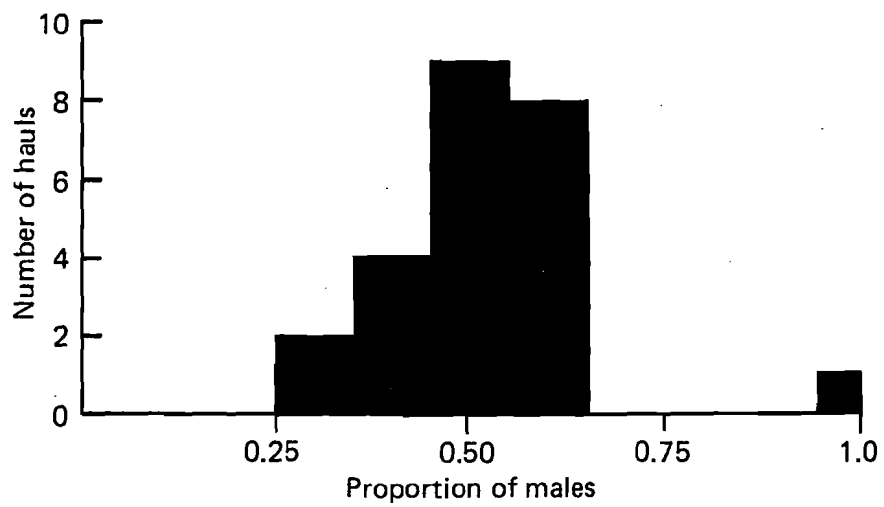


Fig. 5.--Distribution of pollock sex ratios (proportion of males) in trawl hauls.

## Cruise Results

NOAA RV MILLER FREEMAN and RV CHAPMAN

Cruise MF83-01, Leg III and IV and CH83-02, Leg II

Shelikof Strait and Western Gulf of Alaska  
Echo Integrator-Midwater Trawl Survey of  
Spawning Pollock (Theragra chalcogramma)

### Introduction

The largest documented pollock spawning concentration in the western Gulf of Alaska occurs in Shelikof Strait, mainly from mid February through March. A great deal of interest has been expressed in the concentration because of its commercial value and as an indicator of the condition of the pollock stock in the west-central Gulf. In response, echo integration-midwater trawl surveys have been conducted in Shelikof Strait in 1980, 1981 and 1983. The 1983 survey is described and some preliminary results are presented.

### Cruise Period, Area, and Itinerary

#### MILLER FREEMAN

The MILLER FREEMAN completed an echo integrator-midwater trawl survey of Shelikof Strait, and the outer shelf/upper slope (50-200 fm) area southwest of Kodiak Island and along the Alaska Peninsula, on April 13, 1983. During Leg III, a survey of the area between Albatross Bank (southeast of Kodiak) to southwest of Chirikof Island and two surveys of Shelikof Strait were completed (Fig. 1A). The outer shelf/upper slope area from Unimak Island to Chirikof Island and Shelikof Strait were surveyed on Leg IV (Fig. 1B). The cruise itinerary was:

March 2-3	Equipment installation, Kodiak
March 3-20	Leg III survey; Albatross Bank to southwest of Chirikof Island (March 3-6) and 2 surveys of Shelikof Strait (March 6-20).
March 21-22	In-port, Kodiak
March 23-24	Transit to survey area
March 25-April 13	Leg IV survey; Unalaska Island to Chirikof Island (March 25-April 6) and Shelikof Strait (April 6-13).

## CHAPMAN

The **CHAPMAN** completed an echo integrator-midwater trawl survey of Shelikof Strait and the east side of Kodiak Island (Fig. 2) on April 10. The Shelikof Strait survey was started near Kupreanoff Strait and ended west of the Trinity Islands. The east side of Kodiak Island was surveyed from near Cape Trinity to Portlock Bank. The vessel itinerary was:

March 23	Equipment installation, Kodiak.
March 24-April 3	Survey of Shelikof Strait
April 5-10	Survey of Cape Trinity to Portlock Bank area.

## OBJECTIVES

The MILLER FREEMAN and CHAPMAN echo integrator - midwater trawl surveys were conducted as a comprehensive survey of spawning pollock in the western Gulf of Alaska. About 65 percent of the survey effort was expended in Shelikof Strait. The remainder was used to conduct exploratory surveys from Unimak Island to East of Kodiak Island. The primary objectives were to: (1) collect echo integration data necessary to determine the distribution and biomass of the off bottom component of pollock aggregations, (2) collect data necessary to determine their biological composition (sex, size, age and maturity), and (3) to collect data on the timing of peak spawning of the Shelikof Strait concentration.

Data on the on-bottom component of the Shelikof Strait pollock aggregation was collected during a bottom trawl survey conducted by the CHAPMAN (see cruise results; CHAPMAN, Cruise 83-01), during Leg III of the MILLER FREEMAN cruise.

## ACOUSTIC EQUIPMENT AND TRAWL GEAR

### MILLER FREEMAN

Echo integration data were collected using a Biosonics<sup>1/</sup> model 101 echo sounder and a model 120 digital echo integrator. The integrator output was interfaced to a Radio Shack model III computer for preliminary data handling and storage on floppy disk memory. The echo sounder operated at 38 KHz, using a pulse width of 0.6 ms. A dead weight body containing the transducer (6° full beam angle) was towed behind the ship at a depth of approximately 16 m, at a speed of about 8.5 kn.

The midwater trawl used throughout the survey was a Diamond-1000, equipped with a 1.25 in (3.2 cm) ccd end liner. It was fished with two 275 lb (125 kg) tom weights and 6 x 9 ft. (1.8 x 2.7 m) steel Vee doors. Net operation was monitored using a third-wire type, headrope mounted netsounder. The vertical mouth opening varried from 15 to 18 m (about 8-10 fin).

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<sup>1/</sup> Reference to trade names of commercial firms does not imply endorsement by the National Marine Fisheries Service, NOAA.

## CHAPMAN

The echo integration system used on the CHAPMAN was the same as that on the MILLER FREEMAN, except that it included a smaller transducer (10° full angle) mounted in a Vee-fin towing body, which was towed at a depth of about 19 m at an average speed of 7 kn.

Midwater trawl gear was the same as that on the MILLER FREEMAN. In addition, an 83-112 bottom trawl, fished with the same doors as the midwater trawl, was used on 3 occasions. The bottom trawl was also equipped with a 1.25 inch (3.2 cm) mesh cod end liner

## SURVEY METHODS

Surveys were conducted on a 24 hour/day schedule on the MILLER FREEMAN and the CHAPMAN. Echo integration data were collected along zig-zag tracklines with approximate 10 nm spacing between adjacent transect end points except for the second MILLER FREEMAN survey in Shelikof Strait, which had 15 nm spacing. Outside of Shelikof Strait, transects were run between the 50 and 200 fm contours and within Shelikof Strait, between the 50 fm contours. Echo integration values (fish density estimates in kg/m<sup>3</sup>) were output after each 5 minutes of transecting time, for selected depth intervals from 5 m below the transducer to the sea bed.

Trawl hauls were made on selected concentrations of fish for species identification and to obtain pollock biological data and samples. The total number and weight of fish in each haul was determined for each species, either by sorting the entire catch or a sample, depending upon catch quantities. Pollock sex, length and maturity composition data were collected from 150-250 randomly selected fish in every haul. In addition, for most hauls, about 100 individual otoliths and 50 length-weight measurement/stomach content observations were collected. Two special purpose collections of pollock ovaries and one of scales were obtained. A limited amount of data on other species (mostly length frequencies) was also collected.

## RESULTS

The MILLER FREEMAN ran a total of 4398 trackline miles and completed 45 midwater trawl hauls. The CHAPMAN ran 1434 trackline miles and completed 11 midwater and 3 bottom trawl hauls. Trawl haul locations are shown in Figure 3. The frequency of occurrence of species taken in midwater trawl hauls is shown in Table 1. Catch data (by haul) are summarized in Tables 2 and 3. The numbers of pollock sampled for different types of biological data/samples are shown in tables 4 and 5. The total catch by species (% by weight) on the MILLER FREEMAN was: pollock, 91.7%; Pacific cod, 4.5%; eulachon, 2.1% and; other species, 1.6%. The CHAPMAN catch was: pollock, 98.5%; Pacific cod, 0.4%; eulachon, 0.3% and; other species, 1.6%.

With one exception, only trace amounts of pollock were found in the regions surveyed outside the Shelikof Strait-Semidi Island area, so none of those echo integration data were analyzed. A small aggregation of pollock, extending over an area of about 4-5 Km<sup>2</sup> was found near Sanak Island, at Sandman Reefs. In contrast, the area of the pollock aggregation inside the Shelikof Strait-Semidi Island area ranged from 12,123 Km<sup>2</sup>, during its heaviest concentration (just prior to spawning; survey 2, March 16-19), to 19,700 Km<sup>2</sup> after the start of its post spawning dispersion (Fig. 4). Preliminary maturity composition data indicate that peak spawning occurred from March 19-30. During the second MILLER FREEMAN survey of Shelikof Strait (March 16-19), 75 percent of the females (> 30 cm length) were mature and about 3 percent were spawning. In contrast, during the CHAPMAN survey (March 25-April 3), 15 percent of all females (> 30 cm length) were spawning and 65 percent were spent.

The pollock biomass estimates for the first and second MILLER FREEMAN surveys in Shelikof Strait were 2.466 and 2.360 million t, respectively. The estimates for the CHAPMAN survey (0.903 million t) and for the third MILLER FREEMAN survey (0.819 million t) were much lower due to the post spawning breakup of the aggregation which occurred before either survey was conducted. A very low biomass estimate was also obtained for the 1980 survey (conducted during a similar time period), indicating that timing is critical and estimates of peak biomass of the Shelikof Strait aggregation may not be reliable for surveys conducted much outside March 1-25. The major factors that influence the timing of peak spawning are not well known.

The conduct of the Shelikof Strait surveys in relation to the movements of pollock into, and within, the spawning area could have effected the accuracy of biomass estimation. Thus, the average of the survey 1 and 2 biomass estimates (2.413 million t) is considered to be a more appropriate estimate of the peak biomass for 1983 than are the individual survey estimates, and is used throughout the remainder of this report where age specific biomass or populations of pollock are given.

Preliminary estimates were made of age specific biomass and populations of pollock, based on age and age specific weight composition data from eight trawl hauls made during the first leg of the MILLER FREEMAN survey. Age specific biomass ( $B_i$ ) was calculated by;

$$\hat{B}_i = \frac{\bar{W}_i N_i}{(\bar{W}_t N_t)} \hat{B}_t ,$$

where  $\bar{W}_i$  and  $N_i$  are the weight-at mean length and the number of pollock in the eight hauls, at age  $i$ ;  $B_t$  is total estimated biomass. Age specific numbers of pollock in the population were then estimated by dividing  $B_i$  by  $\bar{W}_i$ . Estimated age specific biomass and populations as well as percentage age compositions, sex ratios, mean lengths and weights of the pollock in the eight trawl hauls, are presented in Table 6. Total biomass and confidence interval estimates for the 1980, 1981 and 1983 surveys are presented for comparison in Table 7.

Further analyses and interpretation of the survey data are in progress and will be reported elsewhere.

#### SCIENTIFIC PERSONNEL

##### MILLER FREEMAN

Edmund Nunnallee	(3/2 - 4/61)	Chief Scientist, NWAFC
Martin Nelson	(3/2 - 3/23; 4/6 - 4/13)	Fishery Biologist, NWAFC
Neal Williamson	(3/2 - 3/23)	Statistician, NWAFC
John Garrison	(3/2 - 4/13)	Electronics Tech. NWAFC
Eric Stirrup	(3/2 - 4/13)	NOAA Corps Officer, NWAFC
Greg Jensen	(3/2 - 4/13)	Biological Tech., NWAFC
John Rosapepe	(3/22 - 4/13)	Biological Tech., NWAFC
Daniel Doty	(3/22 - 4/13)	Biological Tech., NWAFC

##### Leg III and IV

##### CHAPMAN

Jimmie Traynor	(3/23 - 4/10)	Chief Scientist, NWAFC
Neal Williamson	(3/23 - 4/10)	Statistician, NWAFC
Dion Powell	(3/23 - 4/10)	Biological Tech., NWAFC
Becky Talty	(3/23 - 4/10)	Biological Tech., NWAFC
Jeff Parkhurst	(3/23 - 4/10)	Biological Tech., NWAFC

##### Leg II

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Table 1. List of species taken by midwater trawl and their frequency of occurrence in 56 hauls during Leg III and IV of MILLER FREEMAN Cruise 83-01 and Leg II of CHARMAN Cruise 83-02.

Species	Frequency of occurrence (no. of hauls)
<b>Lamnidae</b>	
<u>Lamna ditropis</u> (Salmon shark)	1
<b>Rajidae</b>	
<u>Raja binoculata</u> (Big skate)	3
<b>Clupeidae</b>	
<u>Clupea harengus pallasii</u> (Pacific herring)	2
<b>Salmnidae</b>	
<u>Oncorhynchus tshawytscha</u> (Chinook salmn)	2
<b>Osmeridae</b>	
<u>Thaleichthys pacificus</u> (Eulachon)	35
<b>Myctophidae</b>	
(Unidentified lanternfish)	2
<b>Gadidae</b>	
<u>Gadus macrocephalus</u> (Pacific cod)	32
<u>Theragra chalcogramma</u> (Walleye pollock)	56
<b>Scorpaenidae</b>	
<u>Sebastes aleutianus</u> (Rougheye rockfish)	3
<b>Cyclopteridae</b>	
<u>Aptocyclus ventricosus</u> (Smooth lumpsucker)	15
<b>Pleuronectidae</b>	
<u>Atheresthes stomias</u> (Arrowtooth flounder)	19
<u>Hippoglossus stenolepis</u> (Pacific halibut)	3
<u>Hippoglossoides elassodon</u> (Flathead sole)	11
<u>Lepidopsetta bilineata</u> (Rock sole)	2
<u>Reinhardtius hippoglossoides</u> (Greenland turbot)	1
<b>Pandalidae</b>	
<u>Pandalopsis dispar</u> (Sidestripe shrimp)	2
<b>Others</b>	
(Unidentified jellyfish)	14
(Unidentified ctenophore)	1
(Unidentified salps)	1

Table 2. Summary of midwater trawl station and catch data; MILLER FREEMAN Cruise 83-01, Legs III and IV. All hauls except nos. 27-31 were made in Shelikof Strait.

Haul	Date	Time	Start Position		Depth (fm) (Gear/ Bottom)	Duration (Min)	Water Temp. Surface/ Gear (°C)	Catch (lbs)			
			Lat. (N)	Long. (W)				Pollock	Eulachon	Pacific Cod	Other
1	3/9	1300	56°35.0'	155°53.2'	124/142	30	4.5/5.2	1661.5	13.0	12.5	10.0
2	3/9	1600	56°44.2'	155°51.5'	144/159	10	4.2/5.7	1439.5	78.5	13.5	2.0
3	3/10	1300	57°00.0'	155°46.3'	104/151	10	4.0/5.0	367.0	45.5	----	----
4	3/10	1500	56°59.0'	155°41.1'	140/157	10	4.0/5.0	4343.9	18.9	170.0	12.0
5	3/10	1600	56°56.1'	155°40.8'	133/157	20	4.0/5.0	2187.0	5.0	14.0	14.0
6	3/11	1000	57°01.7'	155°01.3'	78/88	25	4.3/5.1	3310.0	2.0	----	----
7	3/11	1200	57°00.7'	155°17.1'	113/137	19	4.0/---	560.5	1.0	----	6.0
8	3/12	1000	57°35.9'	155°08.2'	120/142	1	4.2/---	2100.0	---	26.0	3.0
9	3/12	1100	57°34.1'	155°15.1'	110/153	30	4.2/5.3	566.0	48.5	9.0	7.5
10	3/12	1400	57°19.0'	155°41.5'	136/149	20	3.8/---	3154.3	159.3	----	----
11	3/13	1700	57°29.3'	155°03.2'	114/128	30	4.7/4.8	1989.0	51.3	15.8	21.1
12	3/14	1100	57°52.7'	154°26.6'	79/126	5	4.1/---	6967.0	----	----	----
13	3/14	1200	57°53.6'	154°31.5'	108/130	--	4.0/---	17101.0	----	899.0	----
14	3/14	1600	57°45.3'	155°02.0'	158/170	18	4.2/5.2	No Catch - Gear Problem			



Table 2. (continued)

Haul	Date	Time	Start Position		Depth (fm) (Gear/ Bottom)	Dura- tion (Min)	Water Temp. Surface/ Gear (°C)	Catch (lbs)			
			Lat. (N)	Long. (W)				Pollock	Eulachon	Pacific Cod	Other
15	3/14	1800	57°43.9'	155°02.0'	136/151	7	3.1/6.2	1293.0	1.0	6.0	----
16	3/15	1900	58°00.8'	154°19.4'	128/148	2	3.3/6.1	2950.0	----	----	----
17	3/16	1500	56°50.2'	155°38.6'	140/154	2	4.0/6.0	2823.8	17.2	----	----
18	3/17	1100	57°20.6'	155°28.1'	130/145	1	4.4/---	900.0	----	----	14.0
19	3/17	1300	57°21.9'	155°33.3'	123/155	43	4.4/---	419.0	2.0	----	----
20	3/18	0900	57°46.1'	155°00.3'	153/170	4	4.4/4.6	1225.0	1.0	6.0	3.0
21	3/18	1200	57°35.0'	155°23.8'	149/176	5	4.3/6.3	748.0	----	----	8.0
22	3/18	1400	57°27.2'	155°21. 8'	134/148	4	4.4/---	1282.0	1.0	12.0	5.0
23	3/19	1500	58°08.7'	153°29.2'	95/115	30	4.8/5.2	286.0	5.0	23.0	----
24	3/19	1900	57°58.6'	154°19.6'	114/136	2	5.0/6.5	399.0	----	7.0	0.5
25	3/19	0000	57°47.2'	155°01. 9'	128/145	13	4.6/6.3	751.0	1.0	41.0	2.0
26	3/20	0900	57°27.7'	155°27.4'	138/158	1	4.6/5.9	454.0	1.0	----	----
27	3/25	1700	53°25.8'	165°49.6'	170/275	30	4.7/6.3	1.0	----	----	0.2
28	3/27	Aborted because of trawl system hydraulic problems									
29	3/28	2100	54°30.5'	162°25.6'	46/79	42	2.6/3.2	400.0	----	462.0	5.0
30	3/30	1800	54°31.5'	160°49.1'	140/180	48	3.5/5.4	697.0	----	---	1.0

Table 2. continued

Haul	Date	Time	Start Position		Depth (fm) (Gear/ Bottom)	Duration (Min)	Water Temp. Surface/ Gear (°C)	Catch (lbs)			
			Lat. (N)	Long. (W)				Pollock	Eulachon	Pacific Cod	Other
31	3/31	1600	55°34.6'	160°18.2'	97/103	6	5.0/3.7	1400.00	----	5.0	----
32	4/6	1900	55°55.5'	156°40.1'	36/109	18	5.1/4.5	1390.0	----	----	----
33	4/7	0900	56°25.6'	156°14.5'	118/145	108	4.8/5.0	1765.0	9.0	42.0	4.0
34	4/7	2200	56°38.6'	155°54.7'	100/145	60	5.2/5.5	871.0	54.5	92.0	14.0
35	4/8	1000	56°47.1'	155°09.4'	35/45	30	4.9/5.1	1376.0	----	20.0	4.0
36	4/9	0900	57°08.4'	155°47.2'	138/153	30	5.0/5.0	1616.4	----	157.0	5.1
37	4/9	1100	56°06.8'	155°47.2'	85/151	48	5.0/5.0	512.0	5.0	----	--
38	4/9	2100	57°20.1'	154°57.8'	98/111	12	5.4/5.0	348.0	0.7	----	.6
39	4/10	1200	57°39.8'	155°00.2'	130/140	150	5.4/5.2	1034.0	7.0	43.0	40.0
40	4/10	1900	57°39.9'	154°20.6'	57/71	6	5.4/5.2	483.0	----	----	----
41	4/11	1400	58°01.3'	154°20.1'	105/144	< 1	4.2/5.2	341.0	----	----	----
42	4/11	1600	58°01.9'	154°16.6'	90/150	26	4.2/5.2	417.0	----	----	----
43	4/12	1400	58°36.2	152°47.0	73/104	18	6.6/5.5	352.0	----	----	.09
44	4/12	2000	58°13.5'	153°18.3'	109/118	60	6.2/5.5	2716.9	----	120.0	.7
45	4/13	0600	57°58.9'	154°17.8'	116/129	12	5.4/5.7	1373.0	1.0	70.0	----

Table 3. Summary of midwater and bottom trawl station and catch data; CHAPMAN Cruise 83-02, Leg II.

Haul	Date	Time	Start Position		Depth(fm) Gear/Bottom	Duration (Min)	Water Temp (°C) Surface/Gear	Catch (lbs.)			
			Lat. (N)	Long. (W)				Pollock	Eulachon	Pacific Co	Other
1	3/30	0900	57°50.1'	154°43.8'	118/138	29	5.3/5.0	560.5	0.2	11.0	14.5
2	3/30	1000	57°49.8'	154°42.9'	103/145	13	5.3/5.0	302.5	0.1	3.0	1.7
3	3/30	2000	57°34.1'	155°04.9'	80/130	4	5.1/---	319.5	0.8	10.5	0.5
4	3/30	2100	57°35.7'	155°10.8'	149/150	35	5.1/---	2042.5	0.2	30.1	3.9
5	3/31	2000	57°24.9'	155°11.5'	90/33	24	4.8/---	2958.1	17.2	27.5	1.2
6(B)	3/31	2100	57°24.0'	155°12.6'	133/133	10	4.8/---	1319.4	20.5	45.0	---
7	4/01	1800	56°56.3'	155°14.8'	60/122	15	4.8/---	596.0	----	----	0.2
8	4/01	2000	56°54.1'	155°11.2'	94/120	30	5.0/---	2578.2	46.5	6.0	13.3
9	4/02	1800	56°36.6'	155°22.8'	30/50	26	4.6/---	5220.5	----	----	----
10	4/06	0800	57°03.7'	152°45.1'	75/95	60	4.9/---	95.0	0.1	----	1.0
11	4/06	1800	57°09.2'	152°25.5'	68/83	53	4.8/---	8918.9	----	----	150.0
12(B)	4/06	2000	57°08.5'	152°26.5'	86/86	27	4.6/5.5	2.0	----	22.0	1692.8
13(B)	4/08	0800	57°34.1'	151°46.5'	85/85	30	3.8/---	71.5	----	249.5	2179.0
14	4/09	0800	57°49.6'	148°45.3'	152/154	15	4.6/5.5	297.5	0.5	5.0	7.8

(B) denotes bottom trawl haul.

Table 4. Numbers of pollock sampled for various ~~t~~ of biological data/samples, by haul, on MILLER FREEMAN Cruise 83-01, Leg III and IV

HAUL	LENGTHS	OTOLITHS	MATURITIES	WEIGHTS	STOMACH SCANS <sup>1/</sup>	OVARIES	SCALES
1	357	125	178	53	47	42	—
2	363	51	119	68	52	—	—
3	161	54	54	—	—	—	—
4	378	128	177	49	—	21	—
5	326	—	143	—	51	—	—
6	163	87	123	36	—	—	—
7	118	68	109	41	—	—	—
8	300	117	117	—	—	—	—
9	327	75	75	—	—	—	—
10	244	73	73	—	—	—	—
11	299	123	183	60	52	—	—
12	379	84	138	54	—	—	—
13	302	120	172	52	—	—	—
14	—	—	—	—	—	—	—
15	322	140	264	124	—	—	—
16	268	125	153	28	50	—	—
17	267	133	133	—	—	—	—
18	292	108	127	19	—	—	—
19	237	81	121	40	—	—	—
20	282	139	151	12	—	—	—
21	271	135	159	24	—	—	—
22	290	70	97	27	—	—	—
23	211	107	107 tog	—	—	—	—
24	300	140	216	76	50	—	—
25	281	140	209	69	—	—	—
26	270	132	302 201	69	—	—	—
27	—	—	—	—	—	—	—
28	—	—	—	—	—	—	—
29	295	99	156	57	—	—	—
30	325	100	164	64	—	—	100
31	357	59	119	60	25	—	—
32	280	140	207	67	35	—	—
33	552	137	241	104	24	—	—
34	185	91	129	38	38	—	—
35	343	184	242 216	58	34	—	—
36	286	140	215	75	51	—	—
37	263	123	263	140	52	—	—
38	248	124	159 158	35	10	—	—
39	281	137	205	68	51	—	—
40	343	100	172 198	72	27	—	—
41	341	117	160	43	—	—	—
42	315	135	135	—	—	—	—
43	372	125	125	—	10	—	—
44	140	140	— No	—	—	—	—
45	289	138	138	—	—	—	—
Totals	12,515	4,644	6,566	1,782✓	659	63	100

<sup>1/</sup> Cursory examination of stomach contents with gross estimates of volume for major taxa recorded

Table 5. Numbers of pollock sampled for various types of biological data/samples, by haul, on CHAPMAN Cruise 83-02, Leg II.

HALL	LENGTHS	OTOLITHS	MATURITIES	WEIGHTS	STOMACH SCANS <sup>1/</sup>
1	179	50	<del>199</del> 110	60	—
2	209	50	<del>209</del> 182	133 132	—
3	222	50	<del>222</del> 122	72	—
4	259	—	<del>—</del> 71	—	—
5	237	50	95	—	—
6	313	—	116	—	—
7	380	—	28	28	—
8	271	50	116	66	10
9	302	99	<del>180</del> 179	<del>81</del> 80	20
10	88	88	<del>100</del> 88	<del>—</del> 88	20
11	206	<del>—</del> 25	<del>88</del> 74	<del>78</del> 49	10
12	—	—	—	—	—
13	<del>304</del>	<del>113</del>	<del>210</del>	<del>97</del>	—
<del>—</del> 14	<del>—</del> 304	— 113	<del>—</del> 238	<del>—</del> 125	21
Totals	2,970	<del>550</del> 575	<del>—</del> 1,419	<del>615</del> 700	81

<sup>1/</sup> Cursory examination of stomach contents with gross estimates of volume for major taxa recorded.

Table 6. Preliminary age specific biomass ( $10^3$  t) and population (numbers  $\times 10^6$ ) estimates of pollock and their mean length (cm) and weight (g) at mean length for the first and second ~~MILLER~~ FREEMAN surveys (~~combined~~) of Shelikof Strait in 1983.

	<u>AGE</u>										
	1	2	3	4	5	6	7	8	9	10	11
Sex ratio <u>1/</u>		.53	.46	.55	.60	.63	.58	.50	.60		
Biomass <u>2/</u>	.	28.9	74.2	503.9	767.1	569.7	371.0	65.5	22.4	5.0	5.2
% of total		1.2	3.1	20.9	31.8	23.6	15.4	2.7	0.9	0.2	0.2
Numbers <u>3/</u>		372.0	244.6	1268.9	1452.3	927.4	662.5	91.7	2.5	5.1	5.1
% of total		7.4	4.8	25.1	28.7	18.3	13.1	1.8	0.5	0.1	0.1
Mean length											
Males		22.4	33.6	38.0	41.6	43.3	41.6	45.1	45.3		52.0
Females		23.0	36.6	39.0	42.8	45.8	44.6	47.7	56.0	52.0	
combined		22.7	35.2	38.4	42.1	44.2	42.9	46.4	49.6	52.0	52.0
Weight at mean length (gm) <u>4/</u>											
Males		75.5	259.9	378.1	498.2	562.9	498.2	637.3	646.0		983.5
Females		80.4	344.8	420.7	563.0	696.2	640.6	790.8	1307.5	1036.5	
Combined	.	77.8	303.2	397.1	528.2	614.3	560.0	714.2	878.3	1016.9	1016.9

1/ sex ratio = proportion males

2/ total pollock biomass =  $2,043 \times 10^3$  t (mean of estimates for ~~MILLER~~ FREEMAN surveys 1 and 2)

3/ total number =  $5,055 \times 10^6$  pollock

4/ wights calculated using length/weight regression coefficients

Table 7. Estimated pollock biomass in Shelikof Strait in 1980, 1981 and 1983.

Year	Survey	Survey dates <u>1/</u>	Biomass (t)	95 % Confidence interval (t)		
1980	1	April 11-14	708,983	566,024	-	815,942
1981	1	March 3-15	4,380,032	2,922,163	-	5,837,900
	2	March 24-27	3,147,444	2,073,752	-	4,230,533
	Mean of surveys 1 & 2		3,763,738	2,857,028	-	4,670,448
	3	April 4-10	3,050,096	<b>2,022,384</b>	-	4,077,807
1983	1	March 6-15	2,465,753	1,536,062	-	3,395,445
	2	March 16-19	2,360,348	1,260,685	-	3,460,011
	Mean of surveys 1 & 2		2,413,051	1,693,054	-	3,133,048
	3 <u>2/</u>	March 25-April 3	903,634	466,424	-	1,340,843
	4	April 6-13	818,932	571,784	-	1,066,080

1/ Survey dates include **only** days when echo integration data **were** collected.

2/ Survey conducted by CHAPMAN; **all** others by MILLER FREEMAN.

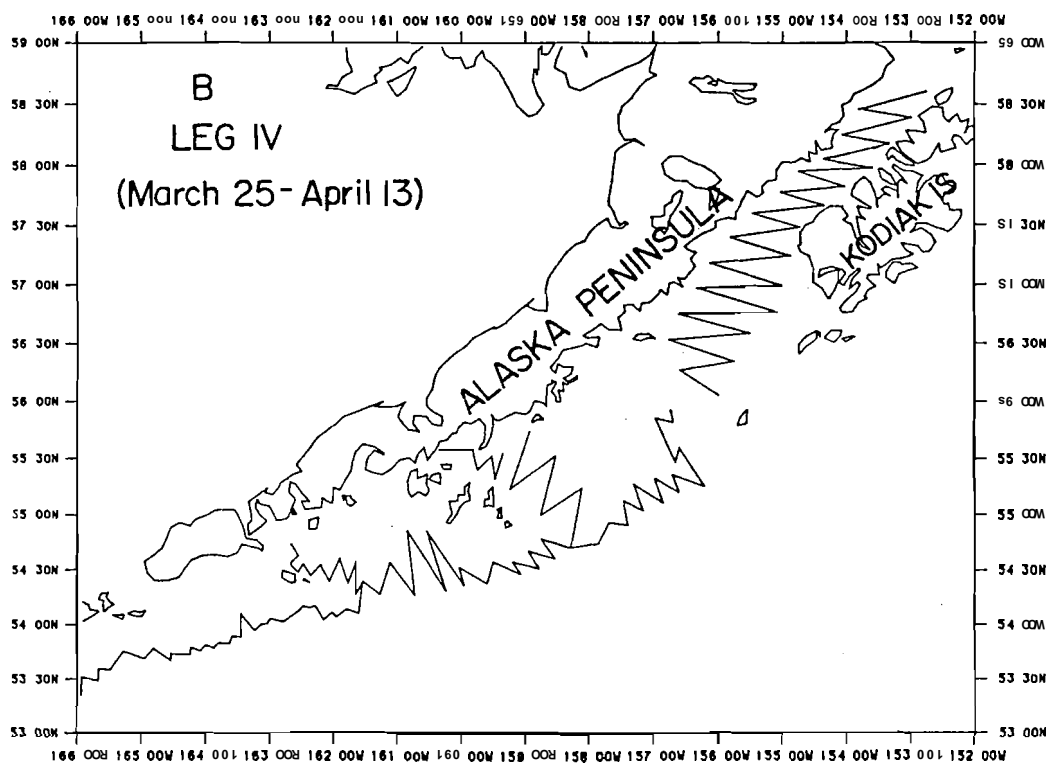
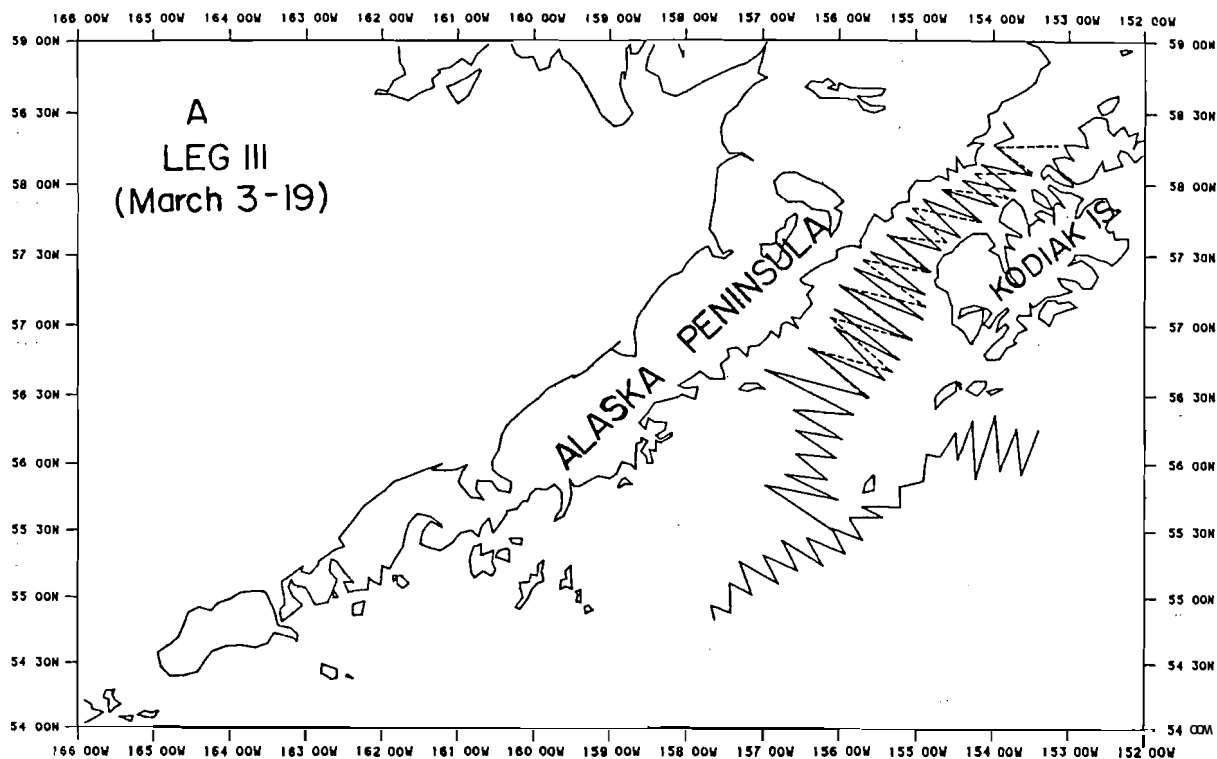


Figure 1. Survey tracklines run by the MILLER FREEMAN during Legs III (A) and IV (B) of Cruise 83-01.



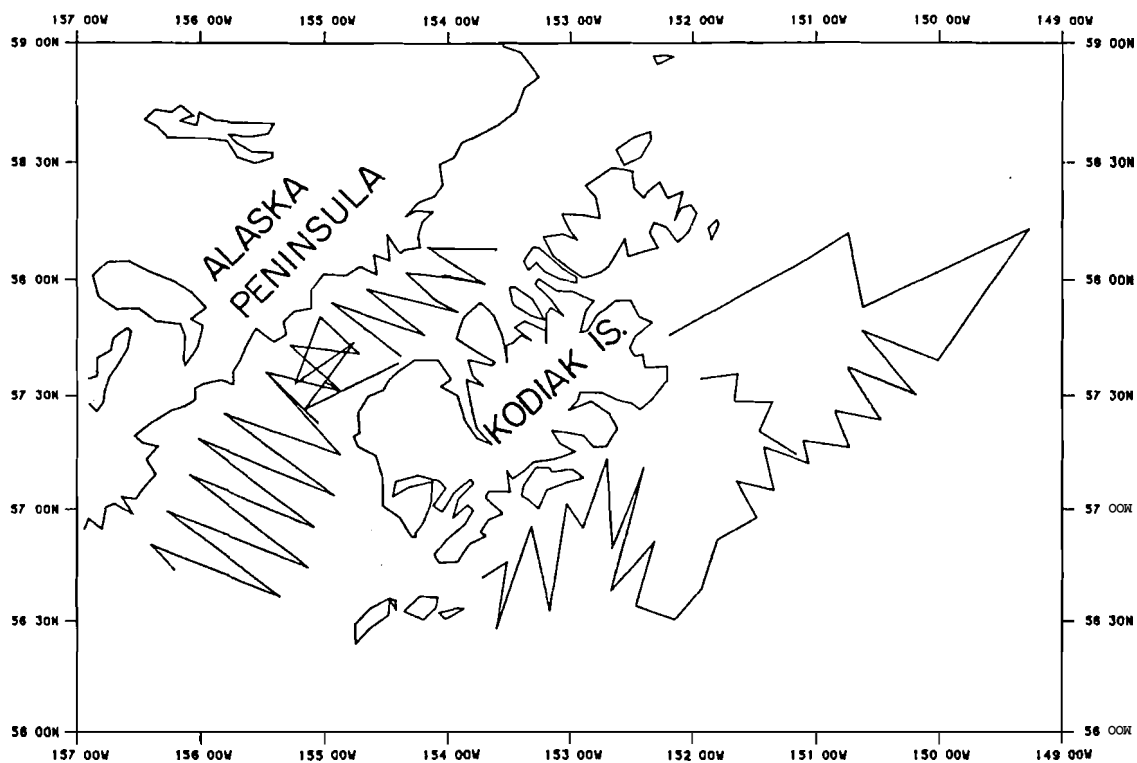


Figure 2. Survey tracklines run by the CHAPMAN during Leg II of Cruise 83-02

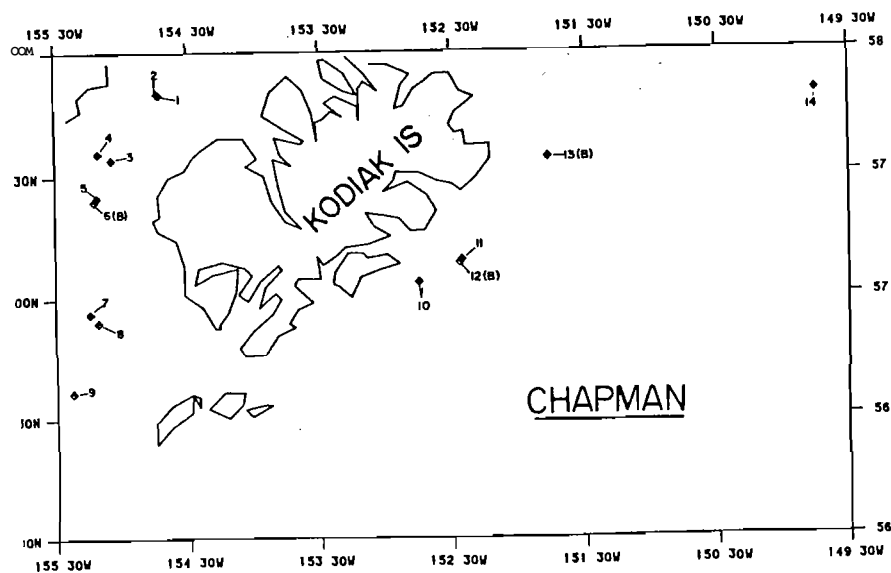
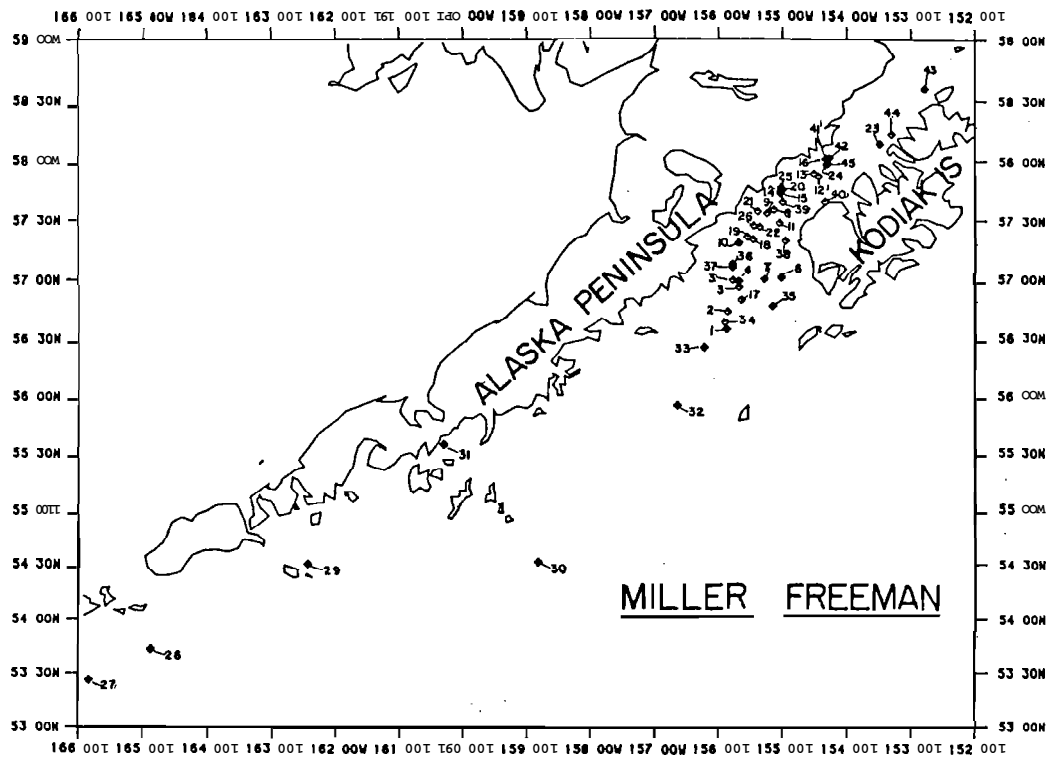


Figure 3. Locations of trawl hauls made by the MILLER FREEMAN during Legs III and IV of Cruise 83-01 (upper) and by the CHAPMAN during Leg II of Cruise 83-02 (lower).

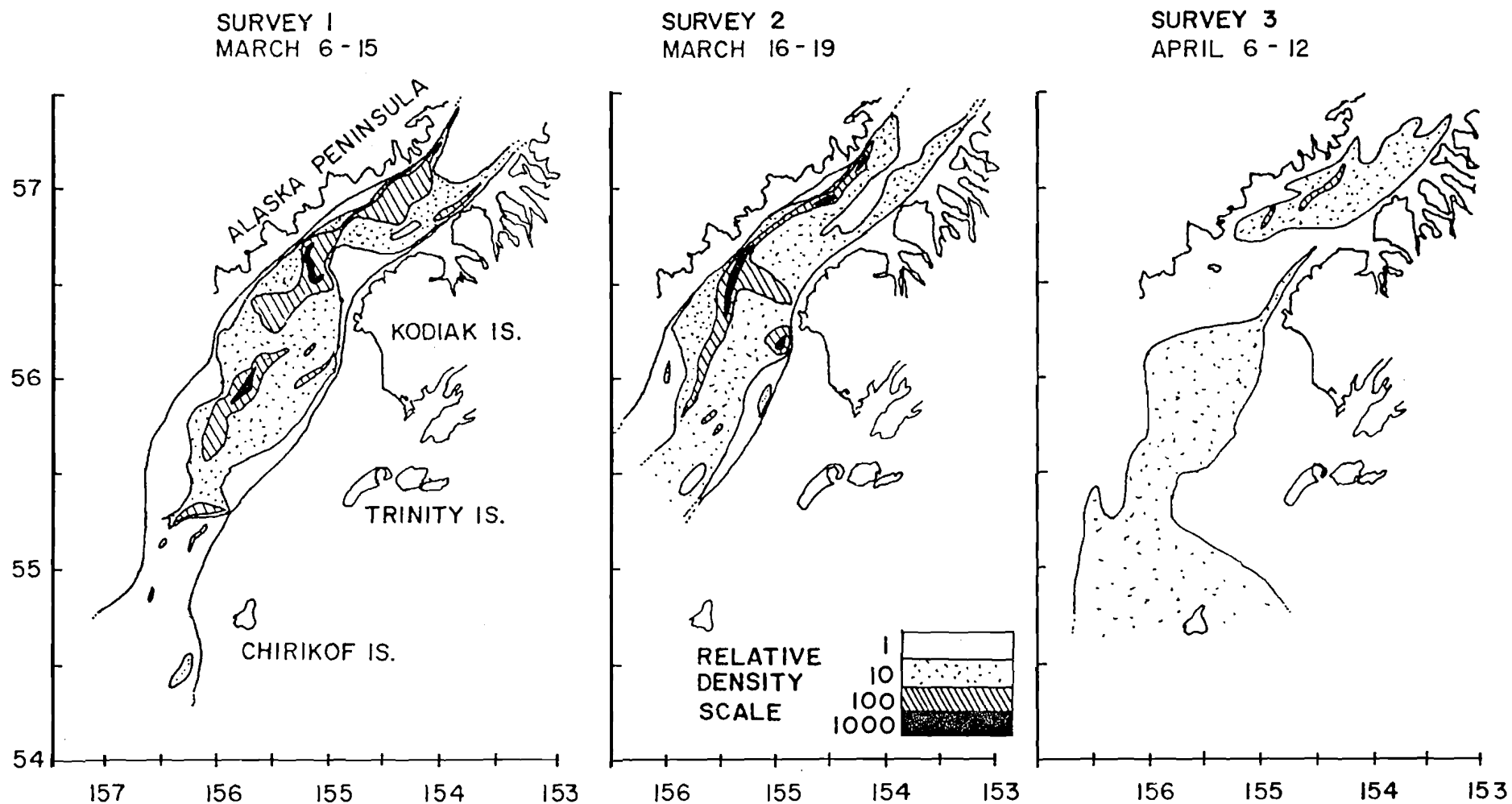


Figure 4. Distribution of relative pollock density in Shelikof Strait during the three surveys conducted by the MILLER FREEMAN; density data from echo integration analysis.